

RESTRICTED

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ENCLOSURE (B) 26

UTILITY TESTS OF AVIATION GASOLINE
WITH INCREASED TETRAETHYL LEAD CONTENT

by

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SUMMARY

Practical engine tests were made, using aviation gasoline with 0.3(vol.)% of tetraethyl lead and 1.3 equivalents of ethylene dibromide added. This gasoline was sent from the First Naval Fuel Depot and tested on typical engines (i.e. SAKAE 20 type and HOMARE 20 type). It was found that aviation gasoline with 0.3 (vol.)% tetraethyl lead was not satisfactory for practical use, because the spark plugs in the engines were fouled and misfire was caused by this fuel after about 10-15 hours operation time. Otherwise, in the case of the usual tetraethyl lead content (i.e. 0.15%) misfire did not occur until after about 30 hours.

I. INTRODUCTIONA. History of Project

In order to obtain a larger amount of aviation fuel from a fixed quantity of base oil, the following investigations were made at the First Naval Fuel Depot.

- (1) Extension of distillation range.
- (2) Increase of final out temperature, and
- (3) Increase of tetraethyl lead content in gasoline to increase the octane number.

A trial sample with 0.3 vol.% tetraethyl lead and 1.3% equivalent ethylene dibromide added, was sent to the First Naval Technical Depot from the First Naval Fuel Depot, to determine whether this fuel was satisfactory for practical use or not.

Endurance tests with this sample were made on typical engines, but detailed and conclusive experimental data are not available, due to the lack of the above-mentioned aviation gasoline, and to the contamination of spark plugs by lubricating oil entering the combustion chamber.

B. Key Research Personnel Working on Project

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II. DETAILED DESCRIPTIONSA. Description of Test Apparatus and Sample

1. Engines: Sakae 20 type
Homare 20 type.
2. The physical properties of fuel samples which were sent from the First Fuel Depot were as follows:

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| | |
|-------------------------------|-----------|
| Density d ₂₀ | 0.75-0.77 |
| Distillation test | |
| Initial drop | 60°C |
| 10% pt. | 90°C |
| 50% pt. | 115°C |
| 90% pt. | 170°C |
| 97% pt. | 180°C |
| Octane No.* | 91 |

B. Test Procedures and Conditions

Outline of endurance test is as follows:

1. Sakae 20 Type (Spark plug Y₁R, porcelain insulators)
(Spark plug Y₁H, mica insulators)

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TEST DATA

| Terms of Test | Boost | Operating Time | hp | RPM |
|------------------|-----------------------|----------------|------|------|
| Rated hp test | +200mm/Hg (1st speed) | 5 minutes alt. | 1100 | 2700 |
| | +200mm/Hg (2nd speed) | 90 times | 950 | 2700 |
| Cruising test | -300mm/Hg (1st speed) | 30 hours | 400 | 2000 |
| Take off test | +350mm/Hg (take off) | 5 minutes alt. | 1120 | 2700 |
| | -350mm/Hg (slow) | 60 times | | 600 |

2. Homare 21 type (spark plug Y₁H)

| | |
|-------------------------|----------------------|
| Boost Pressure | 350mm/Hg (1st speed) |
| Operating Time | 17 hrs. |
| Rated horse power | 1900 |
| RPM | 3000 |

C. Experimental Results

Each spark plug was exchanged with new ones after 10-15 hours in the endurance test of both engines, because of contamination and misfire. The spark plugs were clogged with lead oxide adhering to the surface of the insulator surrounding the center pole. Aviation gasoline containing 0.3 vol.% tetraethyl lead showed the same engine performance compared with the same gasoline with the usual tetraethyl lead content. (i.e. 0.15%) Although in the case of the usual tetraethyl lead content gasoline contamination of lead upon the spark plugs was avoided by increasing the horse-power or the cylinder temperatures, it was very difficult to prevent contamination using the above-mentioned gasoline.

III. CONCLUSIONS

It was found that the fuel samples sent from the First Naval Fuel Depot were not satisfactory for practical use, because it was necessary to exchange the spark plugs at very short intervals, compared with the usual leaded gasoline (i.e. ½ hour). Experiments using aviation gasoline with 0.2 vol.% tetraethyl lead were also planned but were discontinued owing to the shortage of aviation gasoline in Japan.

*Content of tetraethyl lead 0.3 vol.%, content of ethylene dibromide 1.3 equivalent.